[11150/83A]

# ROTARY KNOB FOR A MOTOR VEHICLE

The present invention relates to a rotary knob for operating a motor vehicle by rotating the rotary knob.

Such a rotary knob is known, for example, from DE 101 39 693 A1. According to DE 101 39 693 A1, in the context of modern electronic devices in a vehicle that constantly offer additional functions with more and more options, multi-function operating elements, by which various functions of the connected devices can be performed, have been produced because of the limited installation space for the associated operating elements. Thus, EP 0 366 132 B1 describes, for example, a multifunction operating device for motor vehicles, where function groups and individual functions are selected with the aid of a rotary switch, and where an ENTER function can be triggered; one and the same bidirectional rotary switch being used for selecting menus and individual functions. This rotary switch has click-stop positions, to which menus or individual functions are assigned, the ENTER function being able to be initiated by an axial motion of the rotary switch. Such a multifunction operating device is used, for example, to enter the destination of a navigation system. To this end, an alphanumeric keyboard is illustrated on a display unit, the user being able to move forwards and backwards in the alphanumeric keyboard with the aid of the bidirectional motion of the rotary switch. When the cursor is then situated on the desired alphanumeric character, the latter can be selected by an axial motion of the rotary switch and transferred into the navigation system. From DE 199 41 960 A1, it is also known that an operating element can be designed as a cylinder, which is bidirectionally rotatable about its longitudinal axis and elastically movable with respect to the longitudinal axis.

For convenient operation, and in order to simplify operating haptics, DE 101 39 693 A1 proposes that a bidirectional rotary element be formed, having an axis of rotation extending in a direction essentially parallel to a vehicle-part surface. Using the bidirectional rotary element, a bidirectional preselection and/or selection of function groups and/or functions is made within a menu level. Selection of the menu planes is accomplished via a second operating device. The second operating device can be implemented by moving the bidirectional rotary element parallelly to the axis of rotation of the bidirectional rotary element. To form the second operating device, a further variant provides for the bidirectional rotary element taking the form of a rocker in the direction of the axis of rotation. Another solution provides a second operating device, which has two operating elements that are preferably manipulable in a direction parallel to the axis of rotation of the bidirectional rotary element. The second operating device is situated on or at least partially in the bidirectional rotary element and constitutes a unit with the rotary element. In addition, the bidirectional rotary element is designed for preselection and/or selection in two directions on the indicating apparatus, and the second operating device is designed for selection in two further directions, preferably perpendicular to the selection directions of the bidirectional rotary element.

Also known from DE 31 04 384 A1 is an electrical-unit switch having displays, where a counter records the circuit state brought about by manually operating a freely accessible rotary not, and supplies it to a stationary, electronically functioning display field in accordance with the count, the display field and the rotary knob being situated close together, and a switching contact, which is operated by an

actuating shaft supporting the rotary knob, interacting with the counter. In this context, it is possible to look at the rotary knob and display at the same time, since the electronic display field is built into the rotary knob on its front end face, the electronic display field being supported by a connecting piece projecting above the rotary knob in the rearward axial direction, and the front end face of the rotary knob being essentially transparent all around.

In addition, a push-button switch having a housing and a switching part displaceably supported in it is known from EP 0 329 920 A1. A pushbutton cap used as a manipulating element has a base part having a tubular extension latched to the switching part, and a removable, at least partially transparent, protective cap. An LED or LCD display element having at least one light-emitting diode and/or one liquid-crystal display is situated in a cavity delimited by the base part and the protective cap, the LED or LCD display element being essentially formed by a wafer that is right-angled in the sliding direction of the pushbutton cap, and even being provided with electrical terminals.

A rotary knob is also known from EP 0 771 681 A2.

The object of the present invention is to further improve the operation of a motor vehicle.

The above-mentioned object is achieved by a rotary knob for operating a motor vehicle by rotation of the rotary knob, the rotary knob having a (an at least) partially transparent display layer that rotates along in response to an angular movement of the rotary knob, and a controllable light source for displaying changeable information on the display layer or for projecting the changeable information onto the display layer. In an advantageous refinement of the present invention,

the rotary knob has an axis of rotation, which is aimed to a considerable extent, or essentially aimed, at an observer. In an advantageous manner, an axis of rotation is essentially orthogonal to the display layer.

In a further advantageous refinement of the present invention, the display layer has a side facing an operator and a side facing away from the operator, the side facing away from the operator being able to be illuminated by the controllable light source. In this context, light may be projected onto the side of the display layer facing away from the operator, in the form of an image that is visible on the side of the display layer facing the operator.

In a further advantageous refinement of the present invention, the controllable light source is situated optically in back of the display layer, in particular at a distance of 2 cm to 7 cm away from the display layer, as viewed from the side of the display layer facing the operator.

In a further advantageous refinement of the present invention, the controllable light source includes a laser.

In a further advantageous refinement of the present invention, a movable light beam (whose point of incidence on the display layer is changeable) may be produced by the controllable light source.

In a further advantageous refinement of the present invention, the rotary knob has a scattering lens situated between the controllable light source and the display layer.

In a further advantageous refinement of the present invention, a reflecting mirror, in particular a curved one for deflecting

a light beam is (optically) situated between the controllable light source and the display layer.

In a further advantageous refinement of the present invention, a prism for bending a light beam, in particular one having a curved reflecting surface, is (optically) situated between the controllable light source and the display layer.

The above-mentioned object is also achieved by an operator device for operating a motor vehicle, having at least two above-mentioned rotary knobs which are functionally usable independently of each other in an advantageous refinement of the present invention. In this context, a further advantageous refinement of the present invention provides for different information items being simultaneously displayable on the display layers of the rotary knobs. In accordance with the present invention, the same time can mean the same time in the strict sense of the word, but the same time in the sense of the present invention can also include different points in time, which are so close together that the human eye perceives images, which it sees at these different points in time, as simultaneously displayed images.

In a further advantageous refinement of the present invention, the rotary knobs have a common light source for displaying, in particular, different information items on their display layers.

The above-mentioned object is also achieved by a multifunction operating device for a motor vehicle, the multifunction operating device having a display and an above-mentioned rotary knob and/or an above-mentioned operator device for preselecting and/or selecting menu items representable on the display.

In an advantageous refinement of the present invention, menu items, in particular selected ones, which are representable or represented on the display, are simultaneously representable on the display layer.

In addition, the above-mentioned object is achieved by a motor-vehicle steering wheel, which has an above-mentioned rotary knob and/or an above-mentioned operator device.

In an advantageous refinement of the present invention, at least one rotary knob is situated less than 4 cm, in particular less than 3 cm away from an edge of the steering wheel.

In addition, the above-mentioned object is achieved by a motor-vehicle steering wheel, which has an above-mentioned rotary knob, an above-mentioned operator device, an above-mentioned steering wheel, and/or an above-mentioned multifunction operating device.

A motor-vehicle within the meaning of the present invention is, in particular, a land vehicle that may be used individually in traffic. In particular, motor vehicles within the meaning of the present invention are not restricted to land vehicles having an internal combustion engine.

Further advantages and details are derived from the following description of exemplary embodiments. The figures show:

Fig. 1 an internal view of a motor vehicle;

Fig. 2 a cross-section of an exemplary embodiment of a rotary knob;

Fig. 3 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 4 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 5 a perspective plan view of a rotating body;

Fig. 6 a perspective plan view of a rotating body;

Fig. 7 a perspective plan view of a rotating body;

Fig. 8 a perspective plan view of a rotating body;

Fig. 9 an exemplary embodiment of a multifunction operating device;

Fig. 10 an exemplary embodiment of a screen form;

Fig. 11 a perspective plan view of a rotating body;

Fig. 12 a cross-section of an exemplary embodiment of a rotary knob;

Fig. 13 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 14 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 15 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 16 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 17 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 18 a cross-section of a further exemplary embodiment of a rotary knob;

Fig. 19 a cross-section of an exemplary embodiment of an operator device; and

Fig. 20 a rear view of an exemplary embodiment of an operator device.

Figure 1 shows an internal view of a motor vehicle 1 having a steering wheel 2. A display 3 situated in a console 4 and two rotary knobs 5 and 6 positioned on steering wheel 2 are situated in motor vehicle 1. Rotary knobs 5 and 6 are positioned approximately 3 cm away from an edge 7 of steering wheel 2. Alternatively, or in addition, rotary knobs may also be positioned in the region of console 4. In addition, operating elements 8 are situated in the region of display 3.

Fig. 2 shows a cross-section of a rotary knob 10 as an exemplary embodiment of rotary knob 5 and/or rotary knob 6; rotary knob 10 having a rotating body 12, which includes an at least partially transparent display layer 14 that rotates along in response to an angular movement of rotary knob 10. Display layer 14 has a side 15 facing an operator and a side 16 facing away from the operator. In an advantageous refinement, rotating body 14 has an axis of rotation 18, which is essentially pointed at an observer. In this context, axis of rotation 18 is advantageously oriented essentially orthogonally to display layer 14.

Rotary knob 10 also has a controllable light source 19 for representing changeable information on display layer 14 or projecting the changeable information on the side 16 of display layer 14 facing away from the operator. In this context, light is projected onto the side 16 of the display layer 14 facing away from the operator, in the form of an image that is visible on the side 15 of display layer 14 facing the operator. Reference numeral 17 designates a side wall of the rotating body.

Controllable light source 19 includes a fixed light source 11 and a template 13, which may be changed by a changing mechanism not shown, different images being projectable onto display layer 14 by changing template 13.

Fig. 3 shows a cross-section of a rotary knob 20 as an exemplary embodiment of rotary knob 5 and/or rotary knob 6 that is preferred in comparison with the exemplary embodiment according to Fig. 2. In this case, as in the case of the remaining figures, identical elements are designated by the same reference numerals. Rotary knob 20 likewise has a rotating body 12 having an at least partially transparent display layer 14, which rotates along in response to an angular movement of rotary knob 20. In addition, rotary knob 20 has a light source 21, which is controllable by a control unit 23 and has a laser by which a light beam 22 is movable across display layer 14. Due to the inertia of the human eye, an image is made visible to the operator on the side 15 of display layer 14 facing the operator, by suitably switching light beam 22 on and off and rapidly moving light beam 22 across display layer 14. Seen from the side 15 of display layer 14 facing the operator, controllable light source 21 is positioned optically behind display layer 14 at a distance d1 of 2 cm to 7 cm away from display layer 14.

Light beam 22, which is produced by laser 24, is moved by a suitable mechanism that is known, for example, from WO 03/0365553 and EP 1 168 231 A2. A controllable light source 21 may be taken, for example, from Symbol Technologies, Inc., Holtsville, NY 11742, U.S.A., or from Microvision, Inc., 19910 North Creek Parkway, Bothell, WA 98011, U.S.A. Further details of such controllable light sources may also be extracted from the Internet pages of Symbol Technologies, Inc., e.g. www.symbol.com/products/oem/lpd.html.

The mechanism suitable for moving light beam 22, and laser 24, may be spatially separated and, e.g. connected by an optical waveguide.

Fig. 4 shows a cross-section of a further, preferred embodiment of a rotary knob 30. In this case, a scattering lens 31 is provided between controllable light source 21 and display layer 14. When viewed from the side 15 of display layer 14 facing the operator, controllable light source 21 is likewise positioned optically behind display layer 14, but at a distance d2 of 1 cm to 4 cm away from display layer 14.

Fig. 5 shows a perspective plan view of rotating body 12 at a time at which "TEMP 25°C" is displayed on display layer 14 by light beam 22. Rotating body 12 may rotate in the direction of double arrow 33, i.e. clockwise and counterclockwise. A rotation of rotating body 12 is measured by a suitable mechanism not shown. An exemplary embodiment of such a mechanism may be taken, for example, from DE 31 04 384 A1 or EP 0 771 681 A2. In the present exemplary embodiment, the display "TEMP 25°C" on display layer 14 indicates a setpoint temperature of 25°C set by an air-conditioning system. The setpoint temperature is decreased by rotating rotating body 12 counterclockwise and increased by rotating rotating body 12

clockwise. The corresponding, new setpoint temperature is displayed on display layer 14.

Other languages may be set for the same functionality, using an operator device, which is for control unit 23 and is not shown in Fig. 6 and Fig. 7. In this context, not only Latin letters, but also complex characters, such as those shown in Fig. 6 and Fig. 7, may be displayed by the rotary knob of the present invention. Thus, rotating body 12 in Fig. 6 displays "Temperature 25°C" in the Korean language, and the rotating body in Fig. 7 displays "Temperature 25°C" in the Chinese language.

Other functions may also be set by the operator device or an additional operator device for control unit 23, not shown in Fig. 6 and Fig. 7, or Fig. 8. Thus, Fig. 8 shows the use of rotating body 12 for adjusting a radio. In this context, a received frequency or, as shown in Fig. 8, a selected radio station may be displayed on display layer 14. The received frequency or the selected radio station may be changed by rotating rotating body 12 clockwise or counterclockwise.

The operator devices not shown in Fig. 6, Fig. 7, or Fig. 8 may be, for example, part of operating elements 8 represented in Fig. 1.

Figure 9 shows an exemplary embodiment of a multifunction operator device 40. In the present exemplary embodiment, multifunction operator device 40 has a rotary knob 20 or 30. However, only rotating body 12 is shown. Multifunction operating device 40 has a control unit 41 for controlling controllable light source 21 and evaluating the angular position of rotating body 12.

In addition, display 3 and operating elements 8, or a part of operating elements 8, are components of multifunction operating device 40. A multifunction operating device according to DE 101 39 693 A1 is further developed with the aid of multifunction operating device 40 represented in Fig. 9, rotary knob 20 or 30 replacing rotary element 11 of DE 101 39 693 A1, and operating elements 8 or a part of operating elements 8 corresponding to softkeys 36 of DE 101 39 693 A1.

Fig. 10 shows an exemplary embodiment of a telephone screen form 50, which corresponds to a display according to Fig. 6 of DE 101 39 693 A1. Reference numeral 51 designates a selected menu line or a selected menu item. It is provided that the content of a selected menu line, i.e. the selected menu item, is reproduced on display layer 14, as shown in Fig. 11. Thus, the content of selected menu line 51 in Fig. 10 is the "telephone book" function, which is reproduced on display layer 14. By rotating rotating body 12 counterclockwise, selected menu line 51 is moved up, e.g. to the "telephone number" function. In this case, display layer 14 displays the words "telephone number". By rotating rotating body 12 clockwise, selected menu line 51 is moved down, e.g. to the "messages" function. In this case, display layer 14 displays the word "messages".

In the exemplary embodiments according to Fig. 2, Fig. 3, and Fig. 4, display layer 14 is flat. However, other geometric forms of the display layer are also possible. Thus, Fig. 12, Fig. 13, and Fig. 14 each show a cross-section of an exemplary embodiment of a rotating body 62, 72, and 82, respectively, having a convex display layer 64, a concave display layer 74, and a graded display layer 84, respectively. Such rotating bodies 62, 72, and 82 may replace both rotating body 12 according to Fig. 2, Fig. 3, and Fig. 4, and rotating bodies

12 and 212 according to Fig. 15, Fig. 16, Fig. 17, Fig. 18, Fig. 19, and Fig. 20.

Fig. 15 and Fig. 16 each show a cross-section of a further exemplary embodiment of a rotary knob 90 and 100, respectively, a light beam 92 and 102 being directed onto display layer 14 with the aid of a mirror 91 and 101, respectively, which is positioned between controllable light source 21 and display layer 14. Mirror 91 of rotary knob 90 is flat, while mirror 101 of rotary knob 100 is curved.

Fig. 17 and Fig. 18 each show a cross-section of a further exemplary embodiment of a rotary knob 110 and 120, respectively, a light beam 112 and 122 being directed onto display layer 14 with the aid of a prism 111 and 121, respectively, which is positioned between controllable light source 21 and display layer 14. Prism 111 of rotary knob 110 has a flat reflecting surface 113, while prism 121 of rotary knob 120 has a curved reflecting surface 123.

Fig. 19 shows a cross-section of an exemplary embodiment of an operator device 130 for operating a motor vehicle. Fig. 20 shows a rear view of the exemplary embodiment of operator device 130. The operator device has rotating bodies 12 and 212, which have display layers 14 and 214, may be used functionally independently from each other, and are situated at a distance d3 between 3 cm and 10 cm away from each other. Rotating body 212 has an at least partially transparent display layer 214, which rotates along in response to an angular movement of rotating body 212. Display layer 214 has a side 215 facing an operator and a side 216 facing away from the operator, as well as a side wall 217.

Different information is simultaneously displayable on display layers 14 and 214 of rotating bodies 12 and 212. In accordance

with the present invention, the same time can mean the same time in the strict sense of the word, but the same time in the sense of the present invention can also include different points in time, which are, however, so close together that the human eye perceives images, which it sees at these different points in time, as simultaneously displayed images.

Together with controllable light source 21 and mirrors 131 and 141, rotating bodies 12 and 212 form rotary knobs, which have a common, controllable light source 21 for displaying, in particular, different information on their display layers 14 and 214. As shown in Fig. 19, mirrors 131 and 141 are slightly inclined, so that upper side 140 of mirror 131 and lower side 142 of mirror 141 are visible. In addition, mirrors 131 and 141 are offset from each other, as shown in Fig. 20. In this manner, the two display layers 14 and 214 are simultaneously swept over by light beam 132 in the sense of the present invention: If light beam 132 is moved far enough to the right with respect to Fig. 20, it follows dotted line 133, so that display layer 214 is swept over.

In conjunction with a scattering lens, rotary knobs 90, 100, 110, and 120 according to Fig. 15, Fig. 16, Fig. 17, and Fig. 18, and the operator device according to Fig. 19 and Fig. 20, may be designed in accordance with the exemplary embodiment of Fig. 4.

The elements and layers in the figures are drawn with simplicity and clarity in mind, and not necessarily to exact scale. Thus, the orders of magnitude of certain elements or layers are depicted with considerable exaggeration as compared to other elements or layers, in order to improve understanding of the exemplary embodiments of the present invention.

List of Reference Numerals

| | |
|---|---|
| 1 | motor vehicle |
| 2 | steering wheel |
| 3 | display |
| 4 | console |
| 5, 6, 10, 20, 30, 90, 100, 110, 120 | rotary knob |
| 7 | edge |
| 8 | operating elements |
| 11 | light source |
| 12, 62, 72, 82, 212 | rotating body |
| 13 | template |
| 14, 64, 74, 84, 214 | display layer |
| 15, 215 | a side facing the operator |
| 16, 216 | a side facing away from the operator |
| 17, 217 | side wall |
| 18 | axis of rotation |
| 19, 21 | controllable light source |
| 22, 92, 102, 112, 122, 132 | light beam |
| 23, 41 | control unit |
| 24 | laser |
| 31 | scattering lens |
| 33 | double arrow |
| 40 | multifunction operating device |
| 50 | telephone screen form |
| 51 | menu line |
| 91, 101, 131, 141 | mirror |
| 111, 121 | prism |
| 113, 123 | reflecting surface |
| 130 | operator device |
| 133 | dotted line |
| 140 | upper side |
| 142 | lower side |
| d1, d2, d3 | distance |